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THE "DIOSCURES" FOR THE TACTICAL CONTROL OF AIRPLANES ABOVE THE NORTH ATLANTIC

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ABSTRACT. The article deals with the "Dioscures" Project: a 2-satellite system to aid and control airplanes above the North Atlantic. The project was discussed in November 1966 at the O.A.C.I. meeting. Plans were drafted by French specialists.

In November 1966, an O.A.C.I. meeting discussed Par. 19 of its agenda, dealing with interplanetary communications. The subsequent debate immediately stressed that, from a technical viewpoint, the setting up of a satellite system to aid aerial navigation would be fully justified only if it would provide continuous and precise information to the Ocean Control Centers on the position of airplanes, while also making communications with them possible. At that time, French specialists submitted the first outline of a project which became the "Dioscures" project. They were then requested to join a three-power work unit, (U.S.A., - Canada - United Kingdom) to study the use of satellites for the control and aid of aerial navigation above the oceans. They were especially asked to study problems of propagation, the selection of operating frequencies and methods for taking airplane altitude bearings. This research work, jointly implemented by the specialists of the C.N.E.E., under the direction of M. Manuali and the Aerial Navigation Management of the S.G.A.C., directed by Messrs. Villers (C.E.N.A.) and Giraud (D.N.A), resulted in the definition of the "Dioscures" program.

Two Eyess above the Equator

The project of C.N.E.S. and of S.G.A.C. foresees the use of two identical geostatic satellites, stationed in the 10° and 60° longitude East, weighing 160 to 170 kg. They could be put into orbit with an ELDO-PAS rocket. They would include a receiving system for locating airplanes, two radiotelephone lines, and a line for the transmission of data. This would guarantee a redundant telecommunications system. The airplanes would be located according to their distance from each satellite, and by transmitting their altitude automatically, read from the altimeter coder with a method similar to the C transmission method of the secondary radar Transponder. For locating the position of the satellites with great precision, they will be provided with laser reflectors. They will be located with the method which was experimentally used for the Diadcures" satellites. We will, before long, offer more details of this project which aroused much interest among the specialists of the four-power Commission. Links between the airplanes and the satellites will be maintained on frequency L (1540 to 1660 MHz);

satellite-ground connections can be maintained on standard telecommunication satellite frequencies, i.e.: 4,000 to 6,000 MHz or within the aeronautic frequency, around 5,500 MHz.

The studies of French specialists foresee the obtaining of a sound signal radio at least equal to 20 dB, with a power unit of 20 W installed on the satellite, provided with an antenna (capacity over 20 dB) and a 30 W power airplane transmitter, provided with a 12 to 14 dB-capacity antenna.

Errors due to Transmission

Frequency	Angle de site	Projectory	Erreur (m)	Global error (m)
136 MHz	0°	Low ionosphere	110	
		High ionosphere	4 500 190	4 800
	5°	Troposphère	25	
		Low ionosphere	4 000	
		High ionosphere	150	4 175
	90	Troposphère	2	
		Low ionosphère	1 250	
		High ionosphere	50	1 300
400 MHz	0°	Troposphère	110	
		Low ionosphere	500	
		High ionosphere	20	630
	5°	Troposphère	25	
		Low ionosphere	450	
		High ionosphere	20	500
	90	Low ionosphere	2	
		High ionosphere	140	
			6	148
1 600 MHz	0°	Troposphère	110	
		Low ionosphere	30	
		High ionosphere	1	141
	5°	Troposphère	25	
		Low ionosphere	28	
		High ionosphere	1	54
	90	Troposphere	2	
		Low ionosphere	8	
		High ionosphere	3	10

The "Dioscures" will make it possible for the Ocean Control Centers to track permanently the position of airplanes over the North Atlantic (to approximately 3 km.) and to transmit route correction orders to them as soon as they approach, with a large safety margin. Under these conditions, the ocean flight corridors are reduced to a width of 45 nautical miles.

This chart summarizes, in figures, the reasons which prompted the C.N.E.S. specialists to recommend the use of frequency L for locating airplanes via satellites. The global error in frequency function and in the frequency of the airplane - satellite position angle corresponds to the accumulated transmission speed variations of radio waves in various atmospheric stations (according to data collected for several years). The tropopheric error is not related to the 100 to 10,000 MHz frequency. But the ionospheric error is in inverse proportion to the frequency square. The ionosphere is defined as a zone between altitudes of 1,000 and 36,000 km. An error when locating an airplane can be calculated on the basis of the global error, proportionately to distance; it is approximately 4 times over and above the

global error. It is evident that frequency L is technically the most favorable. On the other hand, it must be stressed that the present congestion of frequencies V.H.F. does not allow the detachment of channels needed for satellite communications, to guarantee adequate immunity from interference between airplanes.

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